

REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, claim 10, the sole independent claim that is presently under rejection in the application, has been amended to recite that the photosensitive resin composition "consists essentially of" the recited (1) polyimide precursor, (2) addition-polymerizable compound and (3) photoinitiator.

In addition, Applicants are adding new claims 24 and 25 to the application. Claims 24 and 25, each dependent on claim 10, respectively recites that the polyimide precursor is a condensation of the oxydiphthalic acid or acid anhydride thereof and the at least one diamine; and recites that the at least one diamine is selected from a specified group thereof, this group being all of the diamines listed in claim 10 except for diaminodiphenyl ether.

The Examiner is thanked for the indicated allowability of claim 23, in the Office Action mailed December 28, 2004.

Rejection of all claims presently in the above-identified application, except for claim 23, under the judicially created doctrine of obviousness-type double patenting, set forth in Items 2-5 of the Office Action mailed December 28, 2004, is noted. The Examiner indicates on page 5 that this double patenting rejection may be overcome by a proper Terminal Disclaimer. Accordingly, and to facilitate proceedings in connection with the above-identified application, enclosed herewith please find a Terminal Disclaimer, satisfying requirements of 37 CFR 1.321(c), in the above-identified application, with respect to U.S. Patent No. 5,856,059. In view of the present filing of this Terminal Disclaimer, it is respectfully submitted that the obviousness-type double patenting rejection is moot.

This Terminal Disclaimer is being submitted in order to facilitate proceedings in the above-identified application, so as to achieve earliest possible issuance of a U.S. patent based thereon. The filing of this Terminal Disclaimer does not constitute agreement with, or an admission as to the propriety of, the obviousness-type double patenting rejection; and does not constitute agreement with, or an admission as to the propriety of, arguments made by the Examiner in this double patenting rejection.

In view of the foregoing, reconsideration and withdrawal of the obviousness-type double patenting rejection is respectfully requested.

Applicants respectfully submit that all of the claims presently in the application patentably distinguish over the teachings of the reference applied by the Examiner in rejecting claims on prior art in the Office Action mailed December 28, 2004, that is, the teachings of U.S. Patent No. 5,472,823 to Hagiwara, et al., under the provisions of 35 USC 102 and 35 USC 103.

Initially, the Examiner's attention is respectfully directed to the second full paragraph on page 7 of the Supplemental Preliminary Amendment filed February 26, 2004, and Applicants respectfully submit that U.S. Patent No. 5,472,823 is disqualified as prior art under 35 USC 103.

Moreover, it is noted that claims 3, 12, 19 and 20 have not been rejected over No. 5,472,823. While the Examiner indicates claim 14 is rejected under 35 USC 102(e), claim 14 has previously been cancelled (should this be claim 17?). The Examiner is respectfully requested to clarify the rejection.

In any event, it is respectfully submitted that the reference as applied by the Examiner would have neither taught nor would have suggested such a photosensitive resin composition as in the present claims, consisting essentially of, in addition to the addition-polymerizable compound and the photoinitiator, the

polyimide precursor produced using an oxydiphthalic acid or acid anhydride thereof and the at least one diamine selected from the specified group thereof as set forth in claim 10, this polyimide precursor having a transmittance, at 365nm, of at least 40%, the composition adapted to be exposed and developed using an i-line stepper which uses monochromatic light. See claim 10.

More specifically, it is respectfully submitted that the applied reference would have neither taught nor would have suggested the other features of the present invention as in the remaining, dependent claims, consisting essentially of the recited components as discussed previously in connection with claim 10, and further including (but not limited to) wherein the at least one diamine is selected from the group as set forth in claim 25; and/or wherein the polyimide precursor is a condensation product of the oxydiphthalic acid or acid anhydride thereof and the at least one diamine (see claim 24); and/or wherein the at least one diamine includes a diaminopolysiloxane represented by the formula (III) as in claim 21, particularly wherein the divalent and monovalent hydrocarbon groups of this diaminopolysiloxane have 1 to 3 carbon atoms (see claim 22); and/or the further definition of the diamine as set forth in claims 12, 13, 17, 19 and 20; and/or wherein the addition-polymerizable compound is tetraethylene glycol dimethacrylate (see claim 11).

The present invention is directed to a photosensitive resin composition, adapted for use with an i-line stepper.

Development of heat-resistant photosensitive materials, which enables the required portion of the resist material to remain, e.g., as a pattern on a semiconductor integrated circuit device after the pattern is formed by exposure to light and development, has been desired. Previously known materials have utilized

a g-line stepper, which employs a visible light of a wavelength of 435nm. However, as further reduction of processing rule in the production of semiconductor devices has occurred, it is required to shorten the wavelength of the stepper used for carrying out finer processing; and, thus, an i-line stepper having a wavelength of 365nm has increasingly been used instead of the g-line stepper having a wavelength of 435nm.

A base polymer of, e.g., a conventional photosensitive polyimide designed for a contact/proximity exposing machine, or a g-line stepper, has substantially no transmittance particularly for the i-line having a wavelength of 365nm. Moreover, a relatively thick polyimide film has been required for surface protection of a lead-on-chip device, and when such a thicker film is used, the low light transmittance for light of the i-line stepper causes more serious problems.

Against this background, Applicants provide a photosensitive resin composition overcoming problems of previously known photosensitive resin compositions, providing a composition which can be used with excellent image-forming ability with an i-line stepper, and which also has excellent film-forming, heat-resistance and adhesive properties. Applicants have found that with a photosensitive resin composition consisting essentially of, in addition to an addition-polymerizable compound and a photoinitiator, a polyimide precursor formed from an oxydiphthalic acid or acid anhydride thereof and at least one diamine as recited in the present claims, the polyimide precursor being such that a 20 μm thick film thereof has a transmittance, at 365 nm, of at least 40%, objectives according to the present invention are achieved; and, in particular, the composition can be exposed and developed by an i-line stepper using monochromatic light. Moreover, this photosensitive resin composition, upon development, has excellent properties

including heat-resistant properties, when used, for example, in manufacturing semiconductor devices.

Hagiwara, et al. discloses, inter alia, a diamino compound represented by the formula (I) at column 2, lines 13-20. This aspect further provides a poly(amic acid) resin having recurring units represented by the formula (II) at column 2, lines 25-40; and discloses a photosensitive resin composition comprising (A) this poly(amic acid) resin having recurring units of the formula (II), prepared by esterifying its carboxyl group and/or a polyimide resin prepared by subjecting them to a dehydrating or alcohol-eliminating ring-closure, and (B) a photoinitiator as an optional ingredient. See column 2, lines 52-59. Note also, for example, from column 25, line 40, through column 31, line 18, for further description of the photosensitive resin composition. In this description in columns 25-31, it is disclosed that the photosensitive resin composition may contain a polymerizable unsaturated compound. Various of the Synthesis Examples in the applied patent disclose formation of various materials, including poly(amic acid) resins. Examples 1-15, as described in column 51 and shown in Table 1 in column 52 of this patent describe photosensitive resin compositions tested, these compositions including, in addition to the poly(amic acid) resin solution, polymerizable unsaturated compound (in some of the examples) and a photoinitiator.

The Examiner contends, in the first paragraph on page 7 of the Office Action mailed December 28, 2004, that Examples 2, 3, 6, 8, 9, 13 and 14, found in Table 1 of Hagiwara, et al., anticipate the claimed invention. This conclusion by the Examiner is respectfully traversed, particularly with respect to the present claims. That is, in all of the examples a diamine is used that includes the diamine compound represented by the formula (I) referred to previously, in column 2 of Hagiwara, et al.

It is respectfully submitted that the Examples in Hagiwara, et al. would have neither taught nor would have suggested the composition consisting essentially of, inter alia, the polyimide precursor of the present claims, and advantages thereof, including, inter alia, having the increased transmittance at 365nm.

Note that Hagiwara, et al. does not disclose a transmittance at 365nm as in the present claims; clearly, Hagiwara, et al. would not have disclosed the present invention; and, as indicated previously, Hagiwara, et al. is disqualified as prior art under 35 USC 103.

As to the specific examples of Hagiwara, et al. referred to by the Examiner at the top of page 7 of the Office Action mailed December 28, 2004, it is to be noted that while Synthesis Example 14 includes at least one of the diamines as listed in claim 10, it does not include a oxydiphtalic acid or anhydride thereof. Moreover, Synthesis Example 19, having at least one of the diamines, does not have the anhydride or acid (having instead an oxydiphthalate).

It is noted that Synthesis Example 7 bridging columns 45 and 46 of Hagiwara, et al. uses oxydiphtalic acid anhydride and 4, 4'-diaminodiphenyl ether; however, this Synthesis Example 7 also uses 4, 4'-bis[3-(2-methacryloyloxyethyl)ureido]-3, 3'-diaminobiphenyl, not listed in the diamines in claim 10; and it is respectfully submitted that this Synthesis Example 7 would not have anticipated a resin composition consisting essentially of the components recited in claim 10.

Furthermore, it is noted that various of the synthesis examples utilize diaminodiphenyl ether. Such compositions would have neither disclosed nor would have suggested that aspect of the present invention as in, e.g., claim 25.

In view of the foregoing comments and amendments, reconsideration and allowance of the claims presently in the application are respectfully requested.

Applicants request any shortage or excess in fees in connection with the filing of this paper, including any extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case 511.33114CC6).

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By 

William I. Solomon
Registration No. 28,565

WIS/ksh
1300 N. Seventeenth Street
Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-312-6666